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CURRICULUM GUIDE

for

SCIENCE 20

(Interim)

PROVINCE OF ALBERTA
DEPARTMENT OF EDUCATION

1953

UNIT SEVEN - ELECTRICITY

1. References:

Hogg, Cross, et al. Physical Sciences for Canadian High Schools, pp. 319-352
Eby, et al. The Physical Sciences
Dull, Modern Physics.

2. Major Concept:

Electricity is a very significant form of energy in the world today. Early study of electrical phenomena in nature, the development of a theory regarding the nature of matter, and the formulation of principles regarding electrical energy have enabled man to utilize electricity in many ways.

3. Generalizations:

a. Physicists have discovered much about the electrical nature of matter. Theories develop and change as new findings are made, and probably much more remains to be discovered.

b. The development and control of electrical potentials, and the designing of machines to utilize them have been major concerns of scientists.

c. An understanding of basic theory is fundamental to the intelligent use of electrical machines and appliances.

UNIT VII - ELECTRICITY

Note: The material of this unit does not follow the order of the text, and in some instances goes beyond.

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
1. To recall the nature of matter.	Review Unit I.	See Unit I.
2. To develop a concept of electrical charges.	a. Demonstrate development of static charges. b. Develop concept of electromotive force resulting by discussion and demonstration of discharges. c. Reports and discussions of static charges developed in nature, in air-	a. Electrons are the "substance" of electricity. b. "Charges" are caused by a surplus or a deficiency of electrons as compared to normal.

Specific Purposes	Suggested Procedures	Understandings
	planes, trucks, automobiles, and industrial machinery to clarify t: theory and concept.	
3. To comprehend the relativity of certain terms used.	a. Demonstrate that changes of varying intensity may be developed, both positive and negative. b. By discussion, clarify the concepts of "negative" and "positive" as being generally descriptive, not specifically indicative of degree of electronic stress. c. Demonstrate and/or discuss that of two positive charges, one may be negative with respect to the other. d. Look at various conductors and insulators; by demonstration and discussion develop concept of relative usefulness according to qualities.	a. States of "negativeness " and "positiveness" exist to varying degrees. b. The terms "negative" and "positive" do not decribe the intensity of electromotive force with respect to a point of reference. c. The ease with which electrons move from one atom to another in a substance indicates its usefulness as a conductor or insulator.
4. To understand three ways in which electrical charges are produced. (i) Friction	a. By reference to Specific Purposes 1 and 2 relate displacement of electrons to friction. b. Develop by discussion and demonstration the concept of "static" as meaning a confined or restricted distribution of electrons.	a. Friction between two bodies of matter may produce an electical charge. b. Such a charge accumulated upon a non-conductor or an insulated conductor is referred to as a static charge.

Specific Purposes	Suggested Procedures	Understandings
	c. Demonstrate development of static charges on non-conductors or on insulated conductors.	
(ii) Chemical action	a. Demonstrate construction of simple galvanic cell.	a. Chemical action involving certain materials will produce electrical charges.
	b. Study a dismantled dry cell; study old car batteries to develop concept of electromotive force between two "plates" or connected terminals.	b. Of several types of cells which develop charges through chemical action, the "dry cell" is one commonly used.
		c. Dry cells have certain characteristics: (i) limited life (ii) limited maximum current (iii) continuous but declining rate of producing charge (voltage)
(iii) Electro-magnetic induction	a. Review and specifically clarify fundamentals by demonstration, discussion, experiment, testing and drilling.	a. Review: permanent magnets, polarity laws; fields.
		b. Current flow creats a magnetic field.
		c. The direction of current flow determines the polarity of the magnetic field.
		d. Specific principles express the relationship of electricity to magnetism.
5. To understand the principles of generation of electricity.	a. Demonstrate that the interaction of lines of force and conductor are essential to induced current; Fig. 38-1, Fig. 38-2.	a. A conductor, a magnetic field of force, and interaction between the two are the basic conditions essential to a generator.

Specific Purposes	Suggested Procedures	Understandings
	b. By reference to process involved in Fig. 38-1 develop concept of change of mechanical energy to electrical, to mechanical.	b. A generator transforms mechanical energy into electrical energy.
	c. By discussion clarify the purpose of both generators and motors in terms of transforming energy. Compare and contrast.	c. Two factors, the direction of the armature rotation and the direction of polarity of the field, determine the polarity of the output of a generator.
	d. By reference to electromagnetism and to Fig. 38-2 extablish direction of current flow in terms of direction of rotation of armature and polarity of fields.	d. The speed of interaction of the conductor and the field, the strength of the field, and the number of armature windings affect the voltage generated.
	e. Demonstrate that the voltage generated may be affected by the strength of the field and the speed of "interaction". (Fig 38-1, Fig 38-2.)	e. Simple D.C. and A.C. generators differ primarily in the mechanical devices used to apply the generated voltage to the external circuit.
	f. Observe the difference between slip rings and commutators; apply principles learned previously to develop understanding of D.C. and A.C. output. (Understanding "e")	f. Pulsating direct, and alternating currents are accompanied by alternating magnetic fields, a condition essential to transforming voltages and currents.
	g. Demonstrate difference between constant direct and puslating direct current.	g. There are definite laws which apply to transformers.
	h. Demonstrate that pulsating direct current, or voltage, may be transformed. Discuss and compare with D.C. proper.	h. The transformation of voltage does not require a closed secondary circuit, whereas the transformation of current does.

Specific Purposes	Suggested Procedures	Understandings
	i. Experiment or demonstrate A.C. transformation; using apparatus as in 38-2, transformers and voltmeters. Refer to power transmission.	
	j. Recall factors which affect voltages of generators; discuss and demonstrate similarity of transformers.	
	k. Recall application of voltage to "open" circuit; reclarify difference between "applied voltage" only and applied voltage resulting in current flow.	
6. To identify the principles upon which a simple motor operates.	a. By discussion and demonstration clarify "purpose" of motion in terms of transforming energy.	a. An electric motor transposes electrical energy into mechanical energy.
	b. Demonstrate repulsion of like poles of magnetic fields.	b. Electric motors basically rely on the interaction of two magnetic fields.
	c. Discuss and clarify principles of operation of a universal motor by either A.C. or D.C.	c. The operation of a universal motor by either A.C. or D.C. is explained by the principles of electromagnetism.
	d. Compare these principles with those pertaining to generators and transformers.	d. Performance of a given motor may be controlled by voltage applied to the armature, strength of field and the external load.
	e. Utilizing knowledge of principles of electromagnetism derive and explain factors which could control power and speed of electric motors.	

Specific Purposes	Suggested Procedures	Understandings
7. To develop the concept of "applied voltage" (a) with current flow. (b) without current flow. (basic to Unit 9, Chapter 47, Vacuum Tubes; Understanding "d")	a. Reclarify concept of static as opposed to current electricity.	a. The voltage, or electromotive force, applied to an external circuit is commonly developed by chemical action (cells) or mechanical action (generators).
	b. Develop concept of closed circuit in light of theory of electrical charge.	b. The current desired in a circuit results from the movement of electrons from the negative terminal of the voltage source to the positive terminal of the voltage source.
	c. Elaborate upon "Electron" flow vs. "current" flow. Reports, discussion on development of theories.	c. This concept, electron flow, replaces the earlier concept of current flow, although texts continue to utilize the latter.
	d. Recall and re-emphasize possibility of applying voltage without current flow.	d. Voltages may be applied where the intention is not to create current flow.
8. To understand simple circuit, and the relationships among voltage, current and resistance.	a. Demonstrate the simplest circuit; differentiate this condition from that commonly called a "short" circuit, and from an "open" circuit.	a. A circuit consists of a source of voltage, conductors, and some appliance designed to utilize electrical power.
	b. Perform simple experiments to extablish general, then specific relationships among the applied voltage, the resistance, and the current flow.	b. Electrical power is used through movement of electrons within the voltage source. This is caused by internal resistance.
	c. Transform pictorial diagrams into schematic diagrams as basis for Ohm's Law problems.	c. For purposes of analysis, circuits can be drawn using symbols. Such diagrams are schematic.

Specific Purposes	Suggested Procedures	Understandings
	d. Use schematics to develop concept of complete circuits using cell, switch and appliance.	d. Definite relationships exist among applied voltage, total resistance in circuit, and the resulting circuit.
9. To be able to to determine the resulting voltages derived from combining cells into batteries.	a. Use combinations of cells and voltmeters to demonstrate the results of various series and parallel cell combinations.	a. The voltage of a battery produced by connecting cells in series in equal to the sum of their individual voltages.
	b. Use ammeters in connection with the above, and plan a simple circuit to establish current relationships.	b. The voltage of a battery produced by joining cells in parallel is equal to that of a single cell.
	c. Apply cells to a lamp designed for higher voltage; add other cells in series, then parallel, and generalize on the resulting effect.	c. Whereas the maximum current available for a series-cell battery remains comparable to that of a single cell, the maximum current in a parallel-cell battery is increased in proportion to the number of cells.
	d. Discuss the theory of charges or voltages to explain the generalizations.	
	e. Utilize simple circuits and values to establish the specific relationships of series and parallel voltages.	
10. To be able to calculate the resulting effect of combining resistance in parallel, series or both.	a. Demonstrate by using simple circuit, and ammeter.	a. The total resistance of two or more resistors in series is equal to the sum of their individual resistances.
	b. Use ammeter in simple circuit, add second resistance in parallel to first, note effect. Generalize.	b. The effective resistance of two or more resistors in parallel is less than the resistance of any one of them. The result is governed by a specific relationship.

Specific Purposes	Suggested Procedures	Understandings
11. To be able to calculate power consumption.	a. Review	a. The watt, kilowatt, and kilowatt hour are basic terms.
	b. Descriptive only; discuss meaning of horsepower as found on electrical motors.	b. There is a definite relationship between kilowatts and horsepower.
12. To recognize that the sensible application of principles should govern the use of electrical appliances.	a. Have students note the ratings on plates found on various appliances and report thereon.	a. Appliances are designed to handle a specific maximum current safely. This is indirectly indicated by marking on them the voltage which should be applied.
	b. Recall series and parallel circuits; use as basis for discussing proper use of outlets and extension cords, and appliances in home.	b. Any conductor has a maximum current rating beyond which excessive heating may occur.
	c. Demonstrate overheating of a common wire; relate this to dangers of overloading house wiring.	
	d. Discuss or demonstrate action of low-rating fuse as a safeguard.	c. Fuses and circuit breakers are safeguards. They indicate that a dangerous or damaging condition exists electrically. Knowledge of simple principles will prevent their misuse.
	e. Discuss purpose of fuses and broker-switches as related to intelligent use of appliances in home, and in case of emergency.	d. The voltage ratings of appliances, the source voltage, and fuse ratings should provide guides to proper use of outlets, and of extension cords.

UNIT EIGHT - LIGHT

1. References:

Hogg, Cross et al: Physical Sciences for Canadian High Schools, pp. 363-390.
Eby et al: The Physical Sciences.

2. Major Concept:

As an indispensable form of energy, light has been of vital interest to man of every age. Light has been studied by scientists with the result that its relationships to life and its uses have become increasingly understood and controlled.

3. Generalizations:

a. The sun is the source of light and heat which supports all life.

b. The control of light and the development of artificial means of producing it have always been a concern of man.

c. There are several theories regarding the nature of light.

d. Our knowledge of light's behavior, aside from theory, has enabled us to accrue many advantages.

UNIT VIII - LIGHT

Specific Purposes	Suggested Procedures	Understandings
1. To appreciate the value of artificial lighting.	a. Study the history of artificial lighting. b. Examine an electric light bulb. c. Report on vapor lamps. d. Demonstrate how illumination is related to candle power and distance. e. Learn the units of measurement for light. f. Discuss good lighting in the home, school and factory.	a. Good artificial lighting is a recent development. b. The tungsten lamp and the vapor lamp are efficient sources of light. c. Strength of a source is measured in candle power; illumination in foot candles. d. Intensity of illumination is proportional to the candle power of the source and inversely proportional to the square of the distance from it.

Specific Purposes	Suggested Procedures	Understandings
		e. Illumination needed depends on the nature of the work being done.
2. To observe the behavior to light.	a. To demonstrate that light travels in straight lines. b. Discuss an experimental method for finding the velocity of light. c. Demonstrate what happens when light strikes: (a) a transparent material (b) a translucent material (c) an opaque body with a smooth surface. (d) an opaque body with a light colored surface. (e) an opaque body with a dark colored surface.	a. Light travels in straight lines with a speed of 186,000 miles per second. b. When light strikes matter it may be reflected, refracted or absorbed. c. Reflection and refraction may be regular or diffused.
3. To make a closer study of reflection.	a. Compare reflection from different surfaces. b. Locate the image in a plane mirror. c. Locate the images in convex and concave mirrors for various positions of the object. d. Discuss causes of glare and ways of combatting it.	a. Light reflects at an angle equal to the incident angle. b. The image in a plane mirror is virtual, erect, and reversed. It is as far behind the mirror as the object is in front. c. Curved mirrors form images of different size and position depending on the location of the object. d. Glare is reflected light that interferes with vision.

Specific Purposes	Suggested Procedures	Understandings
4. To make a closer study of refraction.	a. Demonstrate that light bends when passing from air to water or glass and vice versa. b. Demonstrate refraction by a prism. c. Locate the images formed by a convex lens. d. Discuss the images formed by a convex lens, glass plates, water, etc.	a. When light passes obliquely from one medium to another of different density it bends. b. A convex lens forms images whose characteristics depend on the position of the object. c. Thick plates of transparent materials form images. d. Mirages are caused by refraction of light.
5. To understand the operation of some optical instruments.	Have a student explain the camera. If possible take a picture, develop and print it. a. Study the eye; compare it with the camera. b. Study the microscope. c. Study the telescope.	a. The camera uses refraction to form an image on a sensitive film. b. The eye is similar to the camera. In some ways it is superior and in others it is inferior to the camera. c. A microscope uses refraction to produce an enlarged image. d. Astronomical telescopes may be refracting or reflecting; terrestrial telescopes are refracting. e. Defects of the eye may be corrected with suitable lenses.
6. To appreciate that we live in a world of color.	a. Study and repeat Newton's experiment b. Use colored light and colored objects to show	a. White light is a mixture of several colors. b. Refraction can be used to disperse light.

Specific Purposes	Suggested Procedures	Understandings
	how objects get their color. c. Study how the sky, the rainbow, etc., get their colors. d. Report on the spectroscope and its uses. e. Report on the electromagnetic spectrum.	c. The color of an object depends on the nature of the object and on the light which illuminates it. d. The spectroscope is a useful tool in many branches of science. e. Visible light is only a small part of the electromagnetic spectrum.
7. To understand the nature of light.	a. Study the corpuscular, wave, and quantum theories of light. b. Demonstrate polarization of light.	a. The nature of light is not fully understood. b. Scientists believe light consists of photons and that it behaves like a wave. c. Light can be polarized by refraction or reflection.
8. To appreciate the importance of the mind in seeing.	a. Report on the functions of the retina and optic nerve. b. Discuss how size and distance are judged. c. Discuss the sensation of color; color blindness. d. Discuss optical illusions, after images, color combinations, color printing, color television.	a. Seeing actually occurs in the brain. b. Size and distance can only be judged on the basis of experience. c. The eye can easily be fooled into misjudging size, distance, color.

UNIT NINE - COMMUNICATION

1. References:

Hogg, Cross et al: Physical Sciences for Canadian High Schools, pp. 363-390.
Eby et al: The Physical Sciences.

2. Major Concept:

Means of communication have always existed among men. The development of communication is concerned with man's understanding and utilization of such forms of energy as sound, light, and electricity in such a manner as to overcome more rapidly the limitations of distance.

3. Generalizations:

a. Communication is so important to man that its development has revolutionized society.

b. Our main communication systems today rely upon application of discoveries relating to sound and electrical energy.

c. Rapid advancements are being made. The telegraph, telephone, radio and television may be forerunners only of other developments to come.

UNIT IX - COMMUNICATION

Specific Purposes	Suggested Procedures	Understandings
1. To recognize the importance of communication in the modern world.	a. Discuss the vital part played by various means of communication in making possible the activities of today's world.	a. There are many media of communication.
	b. Collect examples of the use of communications: e.g. in transportation, gathering news.	b. Rapid communication is essential to activities in today's world.
2. To understand the nature of sound - the basic means of communication.	a. Demonstrate various methods of producing sounds.	a. Sound is produced by vibrating objects.
	b. Demonstrate transmission of sound through various media, including a partial vacuum.	b. Sound travels by means of sound waves through various media, the most common being air.

Specific Purposes	Suggested Procedures	Understandings
	c. Study, and demonstrate where possible, such phenomena as sound waves, frequency, pitch.	c. The kind of sound heard depends on the source, the wave length and the frequency of vibration.
	d. Study and demonstrate various instruments used in producing and recording sounds.	d. The speed of sound depends on the medium through which it travels. In air it is about 1100 feet per second.
3. To study the operation of the telegraph.	a. Review the history of the development of the telegraph.	a. The operation of the telegraph depends on the use of the electromagnet.
	b. Construct or examine a model telegraph key and sounder, and experiment with its operation.	
	c. Study the uses of the telegraph.	
4. To study the operation of the telephone.	a. Review the invention and uses of telephones.	a. The telephone is one of the most important means of communication.
	b. Construct a simple model of the essential parts of a telephone, or examine prepared models of microphone and receiver.	b. The microphone operates on the principle of varying electric currents caused by compression of carbon particles.
		c. The receiver operates from an electromagnet.
5. To study the operation of vacuum tubes.	a. Study the principles of the operation of vacuum tubes.	a. Diodes change alternating current to direct currents.
	b. Examine used tubes to learn their structure.	b. Triodes amplify weak electric currents.
	c. Study the uses of vacuum tubes in amplifiers.	

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Specific Purposes	Suggested Procedures	Understandings.
6. To study some of the simpler aspects of radio and electronics.	a. Investigate the production of radio waves in wireless telegraphy. b. Study the application of radio waves to broadcasting of voice and music. c. Study, and possibly construct a simple radio receiver. d. Study in a descriptive way such devices as television, radar, radio beams, etc.	a. Radio waves are electromagnetic waves. b. Radio waves are produced and controlled by various kinds of vacuum tubes. c. There are two common methods of transmitting radio signals: amplitude-modulation and frequency-modulation. The latter is less affected by static. d. Radio waves can be made to vary in both frequency (or wave length) and amplitude (or intensity). e. Television and radar are special applications of radio waves.

UNIT TEN - STRUCTURAL MATERIALS

1. References:

Hogg, Cross, et al: Physical Sciences for Canadian High Schools, pp. 433-458.
Eby et al: The Physical Sciences.

2. Major Concept:

The outstanding achievement of our Western Civilization is the great abundance of material wealth that has been made available to the common people. The average man on this continent lives surrounded by labor-saving machines, tools and implements and in homes usually well-equipped for comfortable living and often made beautiful and attractive by luxurious furnishings, radio, television, telephone, and scores of objects both useful and artistically made.

This has been made possible by the energy and inventive genius of modern man using the scientific method of solving his problems and applying the great accumulation of knowledge to the business of increasing wealth and making it available to all mankind.

In particular, man has developed in recent years a great variety of structural materials which are the basic materials on which our civilization is founded. Among the most important of these are iron, copper, zinc, aluminum, magnesium, glass and cement. It is out of these building materials that our heavy industries are constructed; the machinery from which is turned out the vast assortment of consumer goods that the average man buys in the stores to supply his daily needs.

How these structural materials are taken out of the earth and processed ready for man's use is the subject of our study in this unit.

3. Generalizations:

1. This is the Age of Machinery. The world runs on wheels and on wings at an ever-increasing pace. Efficient machines must be built of the best possible materials.

2. As yet there is no substitute for iron and steel in the manufacture of machines and for the skeleton structure of great buildings.

3. The search for iron ore and the development of efficient methods of smelting and processing of iron and steel is basic to our civilization.

4. The usefulness of steel has been greatly extended by the invention of new alloys, some of great hardness and durability.

5. Four other metals - copper, zinc, aluminum and magnesium - are playing an ever-increasing role in modern construction. Each metal has certain properties which make it unique for certain special purposes, particularly where lightness and non-corrosive qualities are important.

6. Of the non-metallic structural materials, glass and cement play a tremendously important part in our modern world. Many new inventions have greatly increased the variety of uses to which these materials can be put.

7. The achievements of scientists and inventors in making available new materials and in extending the usefulness of old materials is a worthy inspiration to those who would seek to follow their example.

UNIT X - STRUCTURAL MATERIALS

Specific Purposes	Suggested Procedures	Understandings
1. To develop an appreciation of the importance of iron in early times, to locate the chief iron ore deposits and study modern methods of mining.	Have class report on stories of iron in early civilizations and early methods of processing iron.	Iron and steel have always played an important part in history. Those nations which were skilled in steel-processing or had valuable iron ore deposits were often predominant.
2. To understand how the blast furnace works.	Use movies, charts, pictures and diagrams to show how pig iron is obtained from hematite.	In the blast furnace, iron oxide is reduced to iron by the action of carbon or carbon monoxide. Coke is the reducing agent and limestone the flux that keeps the rock (SiO_2) in a molten state. The uses of cast iron are limited by the type of impurities present - chiefly C,S, and P.
3. To gain an insight into steel manufacture from pig iron.	Have groups report on the Bessemer and the Open Hearth steel processes. Have them compare the two methods as to procedure, time and kind of products. Read the story of Kelly's attempt to perfect the Converter process in the U.S.A.	The Bessemer process is more rapid than the Open Hearth but the product is not quite so good. Both types of steel have their particular uses. England's industrial supremacy was due to the Bessemer process. The Open Hearth process supplies the U.S.A. with its enormous annual output.

Specific Purposes	Suggested Procedures	Understandings
4. To understand the ways in which steel may be treated in order to vary its properties.	Experiment with clock-spring to study the effects of heat treatment and tempering. Have students collect information on steel alloys and their special uses.	Properly tempered steel is both hard and flexible and will take a keen edge. The process involves heating iron to red heat, then quenching in water or oil and then re-heating to a desired temperature.
5. To acquire some knowledge of the metallurgy of copper and zinc.	Obtain samples of copper and zinc ores. Compare and study their properties. Study the processes of oil flotation, roasting, smelting, and refining of copper ore.	Copper ores can be identified by their colors such as malachite green, peacock blue. Oil flotation is a useful process for concentrating an ore so as to get rid of the rock or gangue. Roasting an ore involves burning the sulfur out of it. Blister copper, the product of the converter, is about 99% pure.
6. To demonstrate the electrolytic refining of copper and copper plating.	Perform demonstration 50-1, p. 448 of text, to illustrate copper plating and relate the experiment to the electro-refining of blister copper.	The depositing of copper electrolytically on a cathode is useful in such industries as copper plating and electro-typing. The refining of blister copper so as to get a product which is 100% pure is important for use in copper wire for conducting electricity.
7. To learn something of the metallurgy of zinc.	Study the reduction of zinc oxide with carbon or coal dust in clay retorts. Note the use of zinc in alloys and in galvanized iron.	Zinc is obtained by a process of reduction, $ZnO + C \rightarrow Zn + CO$. Brass and white metal are important alloys. Sheet iron dipped in molten zinc gives galvanized iron for use in pails and washtubs.

Specific Purposes	Suggested Procedures	Understandings
8. To become acquainted with the inspiring story of Charles Martin Hall and his successful discovery of a cheap method of extracting aluminum.	Have students report on Hall's process for extracting aluminum from bauxite. Develop the economic implications of this discovery.	Hall's process for the electrolytic extraction of aluminum came at an opportune monment in the development of the aircraft industry. Bauxite, Al_2O_3, dissolves in cryolite and can then be easily electrolyzed.
9. To learn something of the alloys of aluminum and their importance in aircraft construction and in building.	Study the processing of aluminum and its many alloys.	Aluminum can be rolled, forged, cast, extruded, drawn and welded. Duraluminum and Magnalium have many valuable uses related to their particular properties.
10. To form an appreciation of the growing importance of magnesium and of the ocean as a source of light metals,	Perform experiments with magnesium ribbon to acquire knowledge of its lightness and inflammability. Study the extraction of the metal from sea-water and its principal alloys and their uses.	The ocean contains magnesium chloride in great abundance. This is extracted, purified and melted and then electrolyzed to yield pure magnesium. It forms very light alloys useful in airplanes and airplane engine construction.
11. To obtain an insight into the chemical nature of glass and cement and to learn something of their properties and uses.	Have class prepare reports on the history of glass manufacture, modern processes, varieties and uses for glass. Have students observe and report on concrete mixing, cement kilns, and big construction projects in which concrete has been used.	Glass is made from sand, lime and soda to which may be added various metal oxides for special types of glass, such as pyrex, optical glass, cut glass and many others. Fiber glass has many uses for clothing and insulation. Cement is made from limestone and clay fired to the required temperature in a rotary kiln. When mixed with sand and water it makes a durable material for modern buildings, dams, highways, airports and bridges.

UNIT ELEVEN - THE CHEMICAL NATURE OF THINGS.

1. References:

Hogg, Cross et al: Physical Sciences for Canadian High Schools, pp. 469-510
Eby et al: The Physical Sciences.
Black and Conant: New Practical Chemistry.

2. Major Concept: (See also Units I and V)

Chemistry is that branch of science which deals with the nature of substances and their reactions with one another. The science of chemistry is basic to modern life and industry.

3. Generalizations: (See also Units I and V)

a. Man has discovered many of the laws or principles governing the behavior of matter. These have enabled him to make better use of materials in his environment.

b. Many of the improvements in modern living owe their development to chemistry.

c. The growth of understanding of chemistry illustrates the application of the scientific method to the solving of problems.

d. An understanding of chemistry enables the consumer to make more intelligent use of the products of modern industry.

UNIT XI - THE CHEMICAL NATURE OF THINGS

Specific Purposes	Suggested Procedures	Understandings
1. To understand the nature of scientific laws and theories, and to learn some important laws.	a. Read the stories of John Dalton and other early scientists whose work laid the foundations of modern chemistry. b. Do experiments to illustrate some scientific laws. c. Examine and discuss Dalton's atomic theory and the laws derived from it.	a. A hypothesis is a guess, based on observation, as to the possible explanation of a phenomenon or problem. b. A theory is the probable or likely explanation of the behavior of substances under specific conditions. It cannot be proved experimentally. c. A law or principle is a proven statement of facts regarding a scientific phenomenon. It can be

Specific Purposes	Suggested Procedures	Understandings
	d. Illustrate and utilize the steps in the scientific method.	proved experimentally. d. Some basic ideas of chemistry are explained by Dalton's Atomic Theory and by the Law of Conservation of Mass; The Law of Constant Proportions.
2. To study the chemical activity of some acids and metals and the formation of salts and bases.	a. Define an acid and a salt. b. Do experiments to illustrate replacement of hydrogen in acid by a metal. c. Note the comparative activity of some metals and compare with the activity list of metals. d. Experiment to show the formation of calcium hydroxide, a typical base, by replacement of hydrogen in water. e. Test acids, bases and salts with litmus.	a. An acid is a substance containing hydrogen, and in which this hydrogen can be replaced by a metal. b. A salt is the substance formed when the hydrogen in an acid has been replaced by a metal. c. Some metals are more active than others and replace the hydrogen in an acid more readily. Other metals will not replace hydrogen and are chemically inactive. d. A base is the substance formed when part of the hydrogen in water is replaced by an active metal. e. Litmus paper turns red in an acid and blue in a base. A salt does not change its color.
3. To learn the shorthand of chemistry.	a. Show the need for a simple way of writing statements explaining the reactions used in the previous section. b. List and use the symbols for the more common elements.	a. Each element is represented by a symbol - a letter or letters from its English or Latin name.

Specific Purposes	Suggested Procedures	Understandings
	c. Study the valences of common elements and radicals, and show how valence helps to give the correct formulas of compounds. d. Study the naming of common acids, bases, and salts. e. Practice writing the formulas for some compounds and naming them. f. Note the formulas for some of the gas molecules such as O_2 and H_2.	b. Compounds are represented by combining the symbols for the elements. Formulas for compounds show the number of atoms of the elements that combine to form a molecule of the substance. c. Certain groups of elements in a compound do not usually decompose in a chemical reaction. Such a group is called a radical.
4. To understand the meaning of chemical equations and to be able to use them correctly in representing chemical reactions.	a. Demonstrate chemical reactions and practice writing equations to represent the reactions. b. Give practice in balancing equations and discuss the meanings involved. c Practice transcribing word equations into symbolizing equations.	a. A balanced chemical equation shows: i. The reacting substances and the products of the reaction. ii. The composition of the reacting molecules and of the products formed. iii. The number of molecules of each kind involved in the reaction. b. An equation is balanced when the number of atoms of each kind is the same on each side.
5. To study the Ionization Theory as an explanation of chemical reactions in solutions.	a. Review the structure of atoms as studied in Unit I. b. Further study and clarification of valence, and the meaning of ions.	a. An ion is an atom or radical that has an excess or shortage of electrons. If it gains one or more electrons it is a negatively charged ion or an anion. If it loses electrons it is a positively charged ion, or a cation.

Specific Purposes	Suggested Procedures	Understandings
	c. Do experiments to find if solutions of acids, bases and salts conduct electricity. Compare with water. d. Demonstrate the neutralization of an acid by a base. e. Demonstrate and study the properties of acids and of bases. f. Experiment with electrolysis as in copper plating.	b. The positive valence of an ion equals the number of electrons that have been lost; the negative valence equals the number of excess electrons acquired. c. Ions are formed when electrolytes (substances whose solutions conduct electricity) are dissolved in water. The molecules dissociate to form positive and negative ions. d. Strong acids in water are readily ionized to form hydrogen ions (OH^-), while weak bases ionize less readily. e. In electrolysis, the electrolyte is decomposed by an electric current.
6. To survey some uses of chemistry in manufacturing.	a. Individual or group reports on various industries that depend on chemistry, such as the manufacture of: (1) sugar (2) paper (3) soap (4) fertilizers (5) explosives (6) rubber (7) plastics (8) petroleum products	a. Sugar (Sucrose) is a carbohydrate, $C_{12}H_{22}O_{11}$. Chief sources are cane sugar and sugar beets. b. The manufacture of paper is one of Canada's leading industries. Paper is made from the cellulose in wood. c. Soap is the salt of a fatty acid and a base such as sodium hydroxide or potassium hydroxide. d. Chemical fertilizers supply essential elements for plant growth. Some important elements are nitrogen, phosphorus, and potassium; fertilizers are compounds containing them.

Specific Purposes	Suggested Procedures	Understandings
		e. Explosives such as dynamites, T.N.T. and nitroglycerine are derivatives of nitric acid. f. Rubber is derived from the latex of rubber plants, and can also be produced synthetically from petroleum, natural gas and coal. g. There are several kinds of synthetic material called plastics, and these are widely used in manufacturing articles for everyday use.
7. To study the importance of chemistry to the consumer.	a. Study and report on: (1) foods and diets (2) preserving foods (3) patent medicines (4) textiles b. Experiment with methods of preserving foods.	a. A balanced diet including carbohydrates, fats, proteins, minerals, and vitamins is necessary for good health. b. Most foods are destroyed by bacteria unless precautions are taken to preserve them. c. The use of foods and medicines should be based on scientific knowledge, not on fads or popular beliefs.

UNIT TWELVE - THE UNIVERSE

1. References:

Hogg, Cross et al: Physical Sciences for Canadian High Schools, pp. 513-553.
Eby et al: The Physical Sciences, pp. 449-454.

2. Major Concept:

The source of all power on the earth is the energy released by atomic reaction in the sun. Man's recent discovery of how to produce and control atomic energy has tremendous possibilities for future good or evil.

3. Generalizations:

a. All the common forms of energy used by man can be traced to the sun. (See Unit III)

b. The earth is only a tiny part of the vast and limitless universe.

c. Heat from the sun is probably caused by nuclear fusion, the conversion of hydrogen atoms into helium with the release of energy.

d. Man has learned how to produce atomic power, through nuclear fission.

e. The development of atomic energy for industrial purposes has great possibilities for the future.

UNIT XII - THE UNIVERSE

Specific Purposes	Suggested Procedures	Understandings.
1. To show the sun's importance to life, heat, time, etc., on Earth	a. Note effects on plants grown in dark or sunlight. - Photosynthesis. - Outdoor workers vs. indoor workers - Race color.	a. The sun is the source of all life on earth. b. All heat may be traced directly or indirectly to the sun.
	b. Trace such products as coal, oil, cellulose, etc., back to sun.	c. It affects the color, food and clothing of the races of the earth.

Specific Purposes	Suggested Procedures	Understandings
	c. Test speed of evaporation in and out of sunlight. Note effect of this on humidity, weather, climate. d. Study methods of telling time: sundials, obelisks, etc.; and the development of the calendar. (Review Section 1, Unit II). e. Review work of early astronomers and the great observatories of today. f. Study the structure of the sun. What things affect the transmission of heat and light.	d. Weather and climate are largely controlled by the sun. e. Our movements in relation to the sun give us our time divisions, hours, days and years. f. The early astronomers Aristarchus, Aristotle, Ptolmey, Copernicus, Galileo, Newton, differed in their theories, but led up to the knowledge that the sun is the center of our system with planets rotating about it. g. The sun is a mass of hot gases, about 6000°C. on the surface. Sun spots affect telephone, telegraph and radio communication.
2. To gain a knowledge of the origin and parts of the Solar System.	a. Study and discuss arguments for and against such theories as Tidal Theory, Dust Cloud Theory, Nebular Theory, Planetesimal Theory, etc. Observe if possible Nebulae in the sky at present. b. Arrange a chart showing positions and relative sizes of the sun and planets. Demonstrate phases of the moon and eclipses with a planetarium or globe with flashlights.	a. Theories as to the origin of the Solar System change as stronger telescopes are developed. The Dust Cloud or Planetesimal Theory are gaining support at present. b. The Sun's family is made up of nine planets of different sizes, and many smaller bodies called Asteroids. Many planets have satellites or moons. c. The moon affects the earth through tides and the production of eclipses. d. Particles which enter our atmosphere from outer space are called meteors. They usually burn up before reaching the earth. Particles which get through are called meteorites.

Specific Purposes	Suggested Procedures	Understandings
3. To understand make-up of the universe beyond the Solar System.	a. Make a chart of the sky, using the Pole Star as center. Locate the principal stars and constellations that are visible.	a. Stars are suns, some larger, some smaller than ours. b. Unlike planets that reflect light only, stars are gaseous and produce light. c. Distances in the universe are very great and are measured in Light Years. d. The Milky Way is a high concentration of stars in a narrow zone. It is known as a Galaxy. e. Certain stars form patterns or figures called Constellations. f. Because of the earth's rotation constellations visible in the sky vary with the seasons. g. Nebulae are great rotating masses of gases and small particles.
4. To become acquainted with recent developments in atomic energy.	a. Gather and discuss articles, news clippings, etc., dealing with atomic energy. b. Discuss charts or pictorial descriptions found in current literature, and prepared for lay consumption, on splitting the atom.	a. The source of the Sun's heat is not combustion but atomic conversion. b. Certain elements such as radium give off rays and so are called radioactive. c. Radio-active elements will in time turn to lead. d. An atom is composed of protons, neutrons, and electrons. e. Certain atoms may be broken by bombardments of the nucleus with neutrons. f. Fission of atoms releases great amounts of energy in the form of heat.

Specific Purposes	Suggested Procedures	Understandings
		g. This fission may start a chain reaction which if uncontrolled produces a bomb. If controlled and slowed down with a reactor, atomic energy may be used for industrial purposes. h. In the reactor, U235 undergoes fission and U238 is changed to a synthetic element Plutonium.
5. To realize the importance of atomic power. Will it be used beneficially or destructively?	a. Collect information about work with atomic energy at Chalk River and other places. b. Get information about the use of atomic bombs in warfare, and about peaceful uses of atomic and radio-active materials.	a. Earliest developments in atomic energy led to the use of the atomic bomb in 1945. b. Experiments in the production of atomic power for other uses are continuing. c. Canada is playing an important part in research at the atomic plant at Chalk River. d. Radio-active elements play an important role in medical research and practice; e.g., cobalt bomb.

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